Quantum Vacuum Energy Extraction

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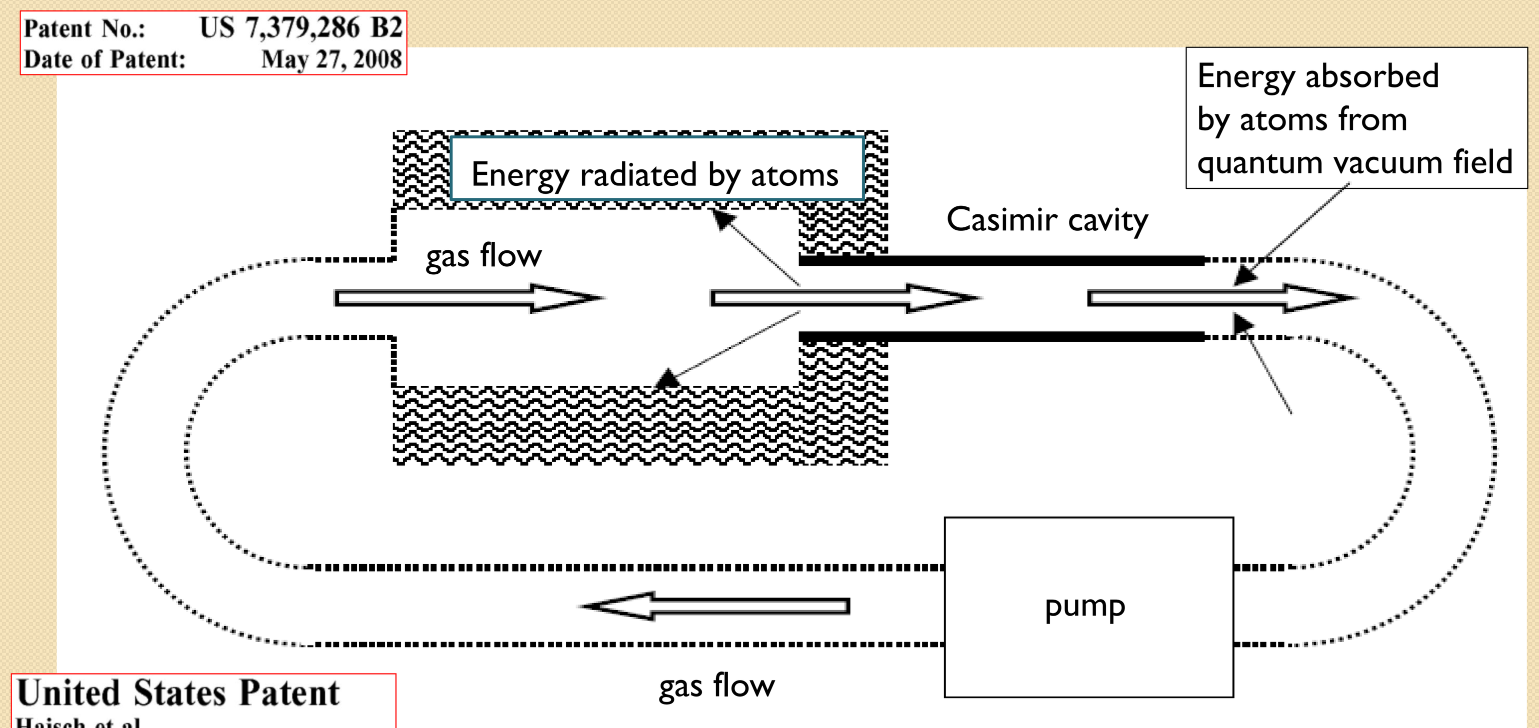
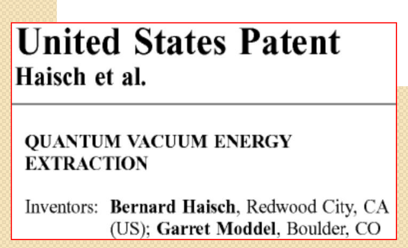
Concept

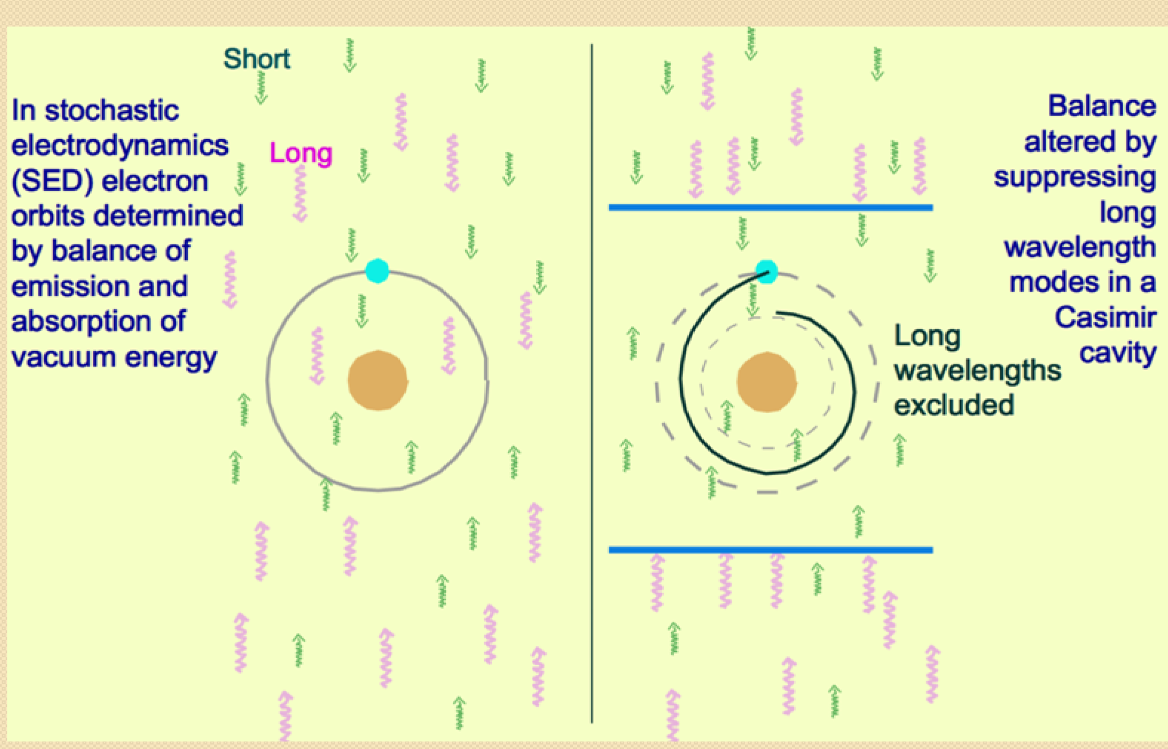
Extraction of quantum vacuum energy by capturing radiation emitted from gas entering Casimir cavities.

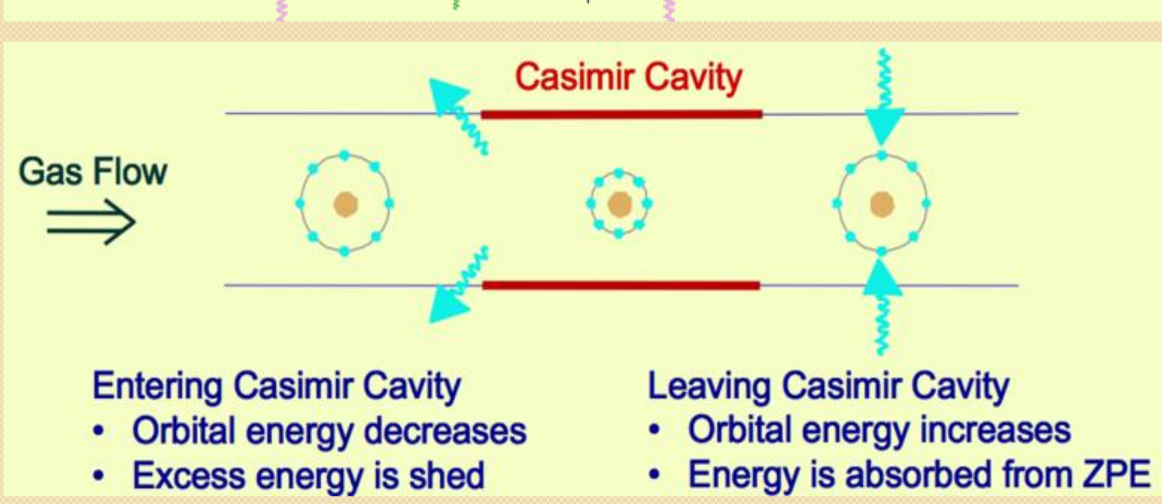




When atoms enter into suitable Casimir cavities a decrease in the orbital energies of electrons in atoms should occur according to Stochastic Electrodynamics (see below). Such energy emission can be detected (extracted)

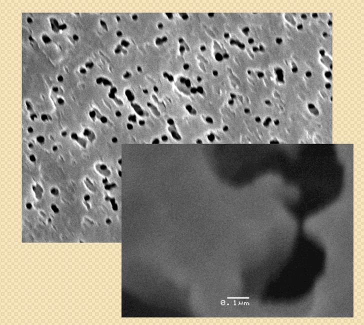
Stochastic Electrodynamics



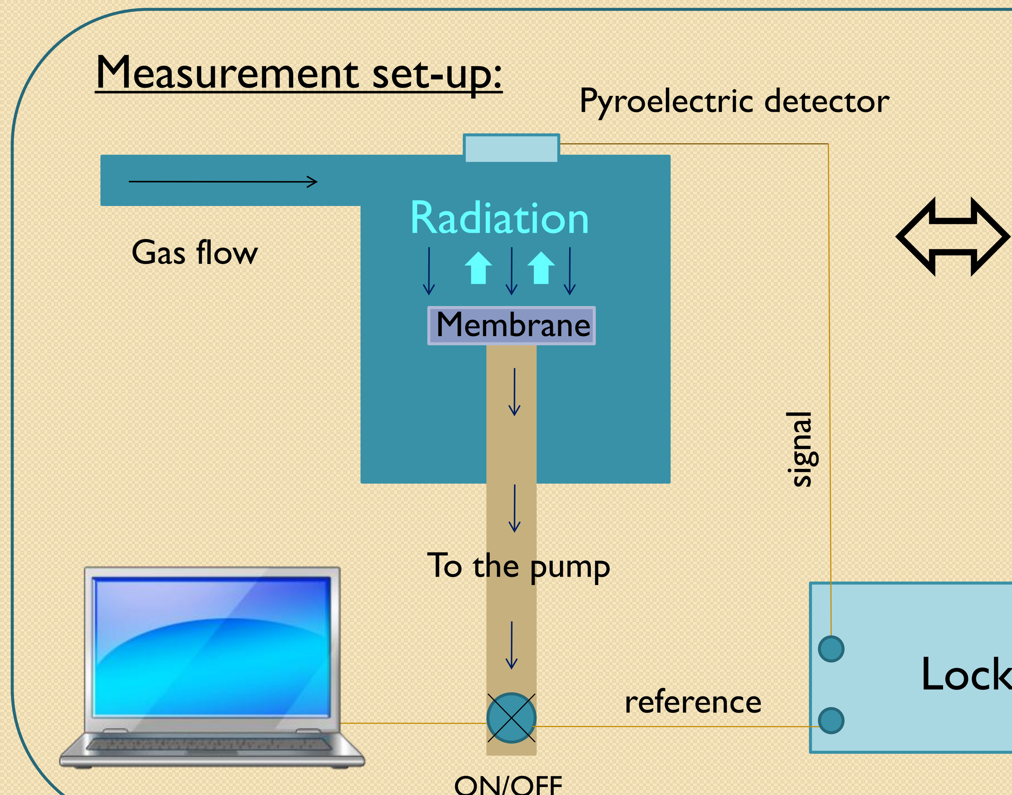


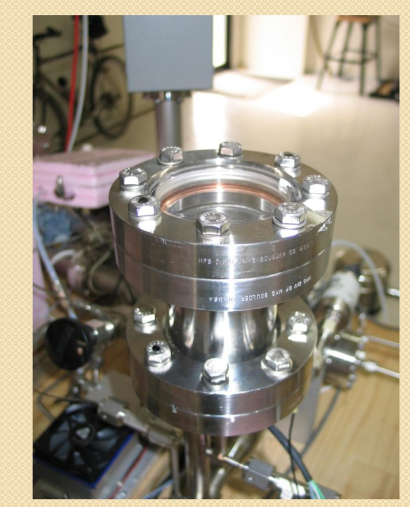
Experiment

Objective: to test for emission from gas flowing into Casimir cavities



Cavities: Whatman Nanopore polycarbonate membranes (pores diameter 0.2-0.4 µm)
Gases:
He, Ar, Xe, N_2





- Vacuum chamber holds membrane.
- Pyroelectric detector placed outside the chamber facing IR transparent window above sample.
- Gas flows into nanocavities (small arrows), while radiation (light blue arrows) expected to be emitted.
- Gas flow modulated by opening/closing valve to pump.
- Valve switch provides reference signal to lock-in amplifier.

We are interested in the output radiation that follows this frequency.

Casimir cavity conditions

Seeking optimum Casimir cavity dimensions to suppress relevant wavelengths.

d < λ/2 – required size of the Casimir cavity

Xenon outer orbital energy corresponds to d = 0.1 - 0.2 µm Casimir cavity size

He λ ≈ 103 nm
Ar λ ≈ 138 nm
Xe λ ≈ 176 nm

Expected power out

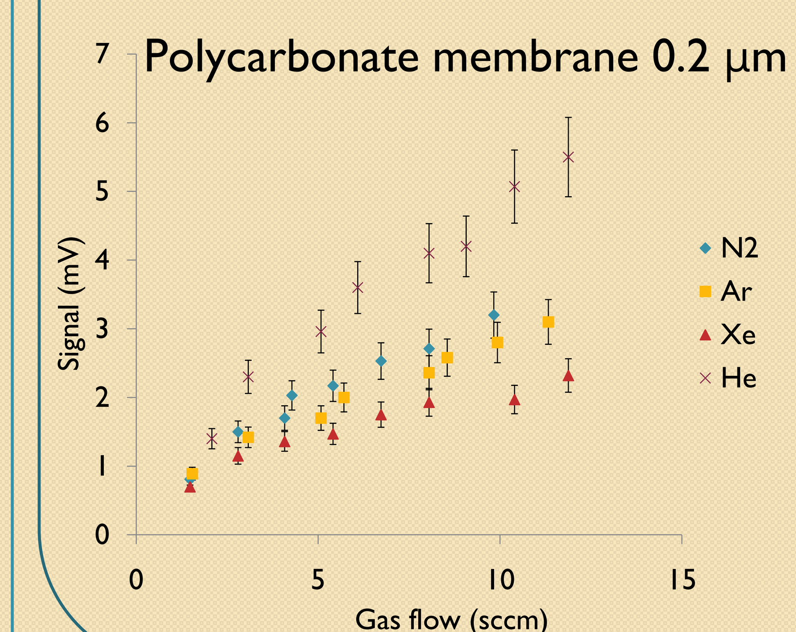
Assuming:
- Release of 1eV of energy per atom per transition
- Porosity 0.1
- Gas flow 10 sccm

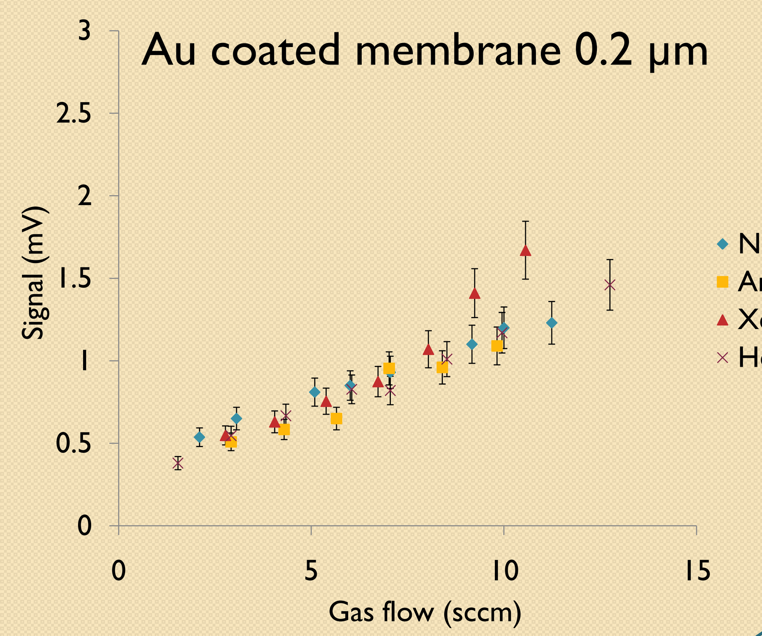
Total radiated power = 80 mW

Findings

Expected:
- Emission to be higher for Xe gas than for other gases (see Casimir cavity conditions calculations section).
- Emission to be higher for gold coated Casimir cavities.

Emission for different gases as function of gas flow for different types of membrane





Observed: experimental results do not follow expected trends:
- Xe does not show the strongest signal
- Emission from gold coated membrane is weaker than from dielectric membrane.

Conclusions

- **Emission observed from gases flowing through Casimir cavities.**
- **No clear evidence that this emission is due to quantum vacuum energy extraction.**

Future Work

- Carry out thermodynamic analysis to determine source(s) for emission other than quantum vacuum energy extraction.
- Experiment with smaller pore sizes.
- Investigate different types of membranes.

Acknowledgement
Work supported by HUB Lab & Jovion Corp.
Special Thanks to Mr. McConnel and Mr. Cantwell from Coolescence